

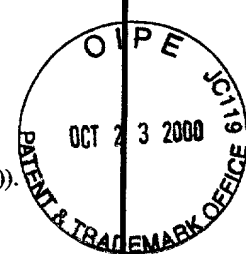
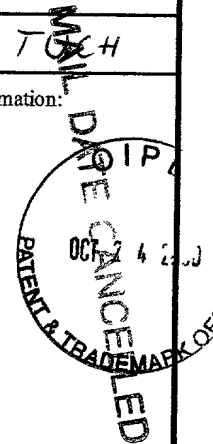
FORM PTO-1590 (REV 10-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER <i>POH 211</i>
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/673986
INTERNATIONAL APPLICATION NO. <i>PCT/DE99/00834</i>	INTERNATIONAL FILING DATE <i>23 MARCH 1999</i>	PRIORITY DATE CLAIMED <i>23 APRIL 1998</i>	
TITLE OF INVENTION <i>CONTACTLESS MEASUREMENT OF WALL THICKNESS</i>			
APPLICANT(S) FOR DO/EO/US <i>Bernd KIESSLING; Peter HERMANN; Carsten TUCH</i>			

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

- ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
- ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
- ☐ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
- ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
- ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - ☐ is attached hereto (required only if not communicated by the International Bureau).
 - ☒ has been communicated by the International Bureau.
 - ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
- ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
- ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - ☐ are attached hereto (required only if not communicated by the International Bureau).
 - ☐ have been communicated by the International Bureau.
 - ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - ☐ have not been made and will not be made.
- ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
- ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
- ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 16 below concern document(s) or information included:

- ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
- ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
- ☐ A FIRST preliminary amendment.
☐ A SECOND or SUBSEQUENT preliminary amendment.
- ☐ A substitute specification.
- ☐ A change of power of attorney and/or address letter.
- ☒ Other items or information:
 - <x> Form PTO-1449*
 - <x> COPY OF THE INTERNATIONAL SEARCH REPORT*
 - <x> REQUEST TO ACCEPT PATENT APPLICATION FOR ENTERING US NATIONAL PHASE*
 - <x> CLAIM OF PRIORITY*



INTERNATIONAL APPLICATION NO.

ATTORNEY'S DOCKET NUMBER

PCT/DE99/00834

POH 211

17. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):

Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO
and International Search Report not prepared by the EPO or JPO **\$1000.00**

International preliminary examination fee (37 CFR 1.482) not paid to
USPTO but International Search Report prepared by the EPO or JPO. **\$860.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but
international search fee (37 CFR 1.445(a)(2)) paid to USPTO **\$710.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482)
but all claims did not satisfy provisions of PCT Article 33(1)-(4).....\$690.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)
and all claims satisfied provisions of PCT Article 33(1)-(4) **\$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =

CALCULATIONS PTO USE ONLY

Surcharge of **\$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
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	NUMBER CLAIMS	RATE
Total claims	6 - 20 =	X \$18.00

Independent claims	2 - 3 =		\$80.00
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MULTIPLE DEPENDENT CLAIM(S) (if applicable)	+ \$270.00
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TOTAL OF ABOVE CALCULATIONS =

☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.

SUBTOTAL

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(f)).

TOTAL NATIONAL FEE

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **\$40.00** per property

TOTAL FEES ENCLOSED

Amount to be	\$
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refunded:	
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charged:	\$
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- a. ☒ A check in the amount of \$ 605.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0224. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

FOR: [REDACTED]

2000

10 10-10-68 Dinner

Warren, N.J. 07059-5832

SIGNATURE:

HORST M KASPER

NAME _____

28,559

REGISTRATION NUMBER

1/PRTS

Method and device for contactless measurement of a wall thickness

The invention relates to a method for the contactless measurement of the thickness of transparent materials and a device for performing the method. The method is particularly suitable for the wall thickness measurement of container glass.

Devices are already known for the automatic contactless or thickness measurement. (DD 261 832, EP 584673, US 4,902,903, US 3,807,870). These devices employ a laser beam, which is directed onto the object to be measured under a certain angle of incidence.

The laser beam is partially reflected on the front side of the object to be measured. A further part of the beam is refracted into the material, reflected at the backside, and is again refracted at the front side such that two laser beams are reflected back from the object to be measured. The distance of the two back reflected laser beams is a measure for the wall thickness and is correspondingly evaluated. In most cases a line sensor is disposed in the beam direction

of the reflexes as an evaluation device.

It is a disadvantage with these devices that they cannot be employed for the measurement of container glass. The surface of the container glass is not smooth when measured at the dimensions of the laser beam. The sharply bundled, parallel laser beam is randomly deflected at the relative uneven grained surface of the container. The reflexes of the laser beam, which in principle are to be employed for the determination of the wall thickness, thereby are frequently not reflected back in the direction of the receiving optics. Thus mostly no reflexes are available for the measurement value formation in the controllers.

It is furthermore disadvantageous in connection with these known devices that the wall thickness measurement value is heavily influenced by the non-parallelity of the wall of the measurement object. The two reflected laser beams are propagated only then in parallel, in case the reflecting surfaces of the object to be measured are disposed in parallel. In the reflected surfaces of the object to be measured enclose that wedge angle, then the two reflected beams diverge or converge, whereby the measured value can be

falsified to such an extent that it becomes useless.

A further erroneous influence is associated with the tipping between the measurement device and the measured object. It is not always assured in particular with measurements in connection with running production that the object to be measured is exactly positioned. The vertical to the surface at the measurement location can therefore deviate in practical situations by a tipping angle relative to the measurement direction of the measurement device.

A device has already been proposed to compensate the measurement errors based on wedge shape of the wall and on tipping of the object to be measured (DE 4143186). The device also employs laser beams and is therefore also not in the position to deliver reliably reflexes at uneven surfaces of container glass. Thus the device is similarly not suitable for thickness measurements at container glass.

It is further disadvantageous in connection with the conventional constructions that in case of heavily wedged or curved surfaces and simultaneously a limited aperture of the receiving lens, the reflexes cannot be imaged onto the

sensor. The reflexes are reflected back in the direction located outside of the opening of the receiving optics and the reflexes thereby are not available for forming a measurement value.

It is an object of the present invention to furnish a method and a device for performing the method, which allow to obtain reliably reflexes even at non-ideally smooth surfaces of the measurement object and thereby measurement values, wherein the measurement values are not simultaneously falsified by wedge walls and tippings of the measurement object and which method and device delivers evaluable reflexes on the sensors even in case of heavily curved, wedged walls despite a limited aperture of the receiving optics.

The object is accomplished according to the present invention in that the light is initially collimated and then focused onto the surface of the object to be measured under an angle of incidence relative to the vertical or normal of the surface. The two reflexes of the light, that occur at the front side and at the backside are imaged onto an opto-electronic image resolving sensor. At the same time the

light from a second illuminating surface is also initially collimated and in the following focused onto the surface of the object to be measured under an angle of incidence, wherein the angle of incidence corresponds angle of reflection of the reflected beam from the first illuminating surface. The reflexes of the second light beam are imaged onto a second opto-electronic image resolving sensor. The average value of the distances of the respective two reflexes on the opto-electronic image resolving sensors are determined as a measure of the wall thickness in a following controller.

The essence of the invention comprises to image illuminating surfaces onto the surface of the object to be measured. The impingement of the surface of the object to be measured occurs from the most different directions of incidence by employing a diffusely illuminating surface instead of a sharply bundled laser beam. The course of beams out of an illuminating surface, wherein the course of beams is focused on the surface of the container, contains a large bandwidth of light bundles, which impinge onto the container surface from different angles of incidence. This assures that parts of the course of the beams are always reflected back into

the receiving optics despite the grained, uneven surface of the object to be measured, even though other bundles out of the beam course are not available based on these surface defects. Thus always two reflexes are generated on the optoelectronic image resolving sensor.

Furthermore the measurement errors based on wedge shape and tipping are compensated by a second optical system, which exhibits the identical construction of the first system, however, operates with a reversed beam direction and the imaging of the reflexes onto the sensors is assured based on the widely opened beam bundles even in case of heavily curved surfaces and wedged walls despite limited aperture of the receiving optics.

The advantage of the invention comprises that it allows a reliable measurement at grained, uneven surfaces, that measurement errors based on wedge shape of the wall and tipping of the object to be measured are avoided as that it becomes possible to work with limited apertures of the receiving optics and that thereby size of the measurement arrangements is kept within a justifiable frame. An embodiment example of the invention is shown in the drawing

and is explained in more details in the following.

The illuminating surface 11, which for example is realized by a line shaped light exit opening of a light guide, is followed by lens 12. This lens generates a parallel beam from the diverging beam exiting from the illuminating surface 11, wherein the parallel beam is directed into the objective 14 through the semi permeable mirror 13. The objective 14 focuses the beam onto the surface of the container 1 under an angle of incidence. Two reflexes are reflected back from the surface of the container 1 from the front side and from the inner side of the container. These two reflexes are imaged through the objective 24 and through the semi permeable mirror 23 and further through the lens 25 onto the line sensors 26. The controller 3 is disposed following to the line sensor 26, wherein the controller 3 determines the distance of the reflexes and uses the distance of the reflexes as a base for the further calculation of the wall thickness.

At the same time the lens 22 is disposed following to the illuminating surface 21, wherein the illuminating surface 21 is again realized by a line shaped light exit opening of a

light guide. Again this lens generates a parallel beam from the diverging beam which exits from the light guide 21, wherein the parallel beam is directed to the semi permeable mirror 23 into the objective 24, wherein the objective 24 also focuses the beams under an angle of incidence onto the surface of the container 1. This angle incidence corresponds to the exit angle of the reflexes from the first illuminating surface 11. Similarly two reflexes derived from the front side and from the inner side of the container are reflected back from the surface of the container 1. These two reflexes are imaged through the objective 14, through the semi permeable mirror 13 and further through the lens 15 onto the line sensor 16. The line sensor 16 is again connected to the controller 3, wherein the controller 3 also determines the distance of these two reflexes and uses the distance of these two reflexes as a base for the further calculation of the wall thickness. The wall thickness is finally determined by an averaging of the distances of the reflexes on the two sensors 16 and 26.

The beams coming from the illuminating faces 11 and 21 are composed of light bundles, wherein the origin of the light bundles lies in each case at different points of the

illuminating surface. The different bundles of the beams therefore have different inclination angles relative to the surface of the object to be measured. Therefore the grained, uneven surface of the object to be measured will deflect only those bundles of the beam from the ideal direction of reflection, which impinge by chance with an unsuitable direction of incidence. In contrast other bundles of the beam are reflected into the direction of the receiving optics despite the surface defects and contribute there to the formation of the two reflexes on the sensors 16 and 26. If a laser beam would be employed for generating the two reflexes at the outside and at the inside, as it corresponds to the state-of-the-art, then one would in most cases obtain no reflexes on the opto electronic receiver, since the narrowly bundled laser beam, which impinges the object to be measured always from the same angle of incidence, is deflected stochastically at the unevennesses of the surface in the majority of cases.

The measurement errors based on wedge shape and tipping are compensated by directing the light from two illuminating surfaces and from opposite directions onto the object to be measured, wherein the exit direction of the first beam

corresponds to the direction of incidence of the second beam.

The construction of the beams employed for measurement from a broad spectrum of differently inclined bundles has finally the consequence that even in case of heavily wedged or curved surfaces and simultaneously a limited aperture of the receiving objective, the two reflexes can always be formed on the sensor. In fact bundles are reflected back from the beams such as that they miss the receiving optics, however, other bundles contribute to an image generation on the sensor, such that it is possible to work also with limited apertures of the receiving optics.

Invention claim

1. Methods for contactless measurement of the wall thickness of transparent object to be measured by employing of light sources, lenses, deflection mirrors or deflection prisms, semi permeable mirrors as well as line sensors and a controller, characterized in that the light from the illuminating surface (11) is initially collimated and in the following focused onto the surface of the object to be measured (1) under an angle incidence relative to the normal of the surface, wherein the two reflexes of light, which reflexes occur at the front side and at the back side, are imaged furthermore onto the opto-electronic image resolving sensor (26) and wherein the light from the second illuminating surface (21) is simultaneously also initially collimated and in the following focused in the direction toward the surface of the object to be measured (1), wherein the direction toward the surface of the object to be measured (1) corresponds to the exit direction of the light from the illuminating face (11), and wherein furthermore the reflexes of the second beam are imaged onto the second opto-electronic image resolving sensor (16) and wherein the average value of the distances of the respective two

reflexes on the two opto-electronic image resolving sensors is evaluated as a measure of the wall thickness in a following disposed controller (3).

2. Device or contactless measurement of the wall thickness of transparent object to be measured employing light sources, lenses, semi permeable mirrors or semi permeable prisms as well as image resolving sensors and a controller, characterized in that the lens (12) is disposed following to the first illuminating surface (11), wherein the semi permeable mirror (13) is disposed behind the lens (12) in such way that the light is reflected into the objective (14) and is further focused onto the measurement object (1) and wherein furthermore the objective (24) is disposed such that the objective (24) together with the lens (25) images the beams reflected at the object to be measured onto the sensor (26) through the semi permeable mirrors (23) and wherein the lens (22) is simultaneously coordinated to the second illuminating face (21), wherein the semi permeable mirror (23) is disposed following to the lens (22) in such way that the light from the second illuminating face is focused also onto the object to be measured (1) the objective (24), wherein the direction of incidence of the

light corresponds to the exit direction of light from the first illuminating face and wherein the reflexes are imaged onto the sensor (16) through the objective (14), wherein the controller (3) is connected following to the two sensors.

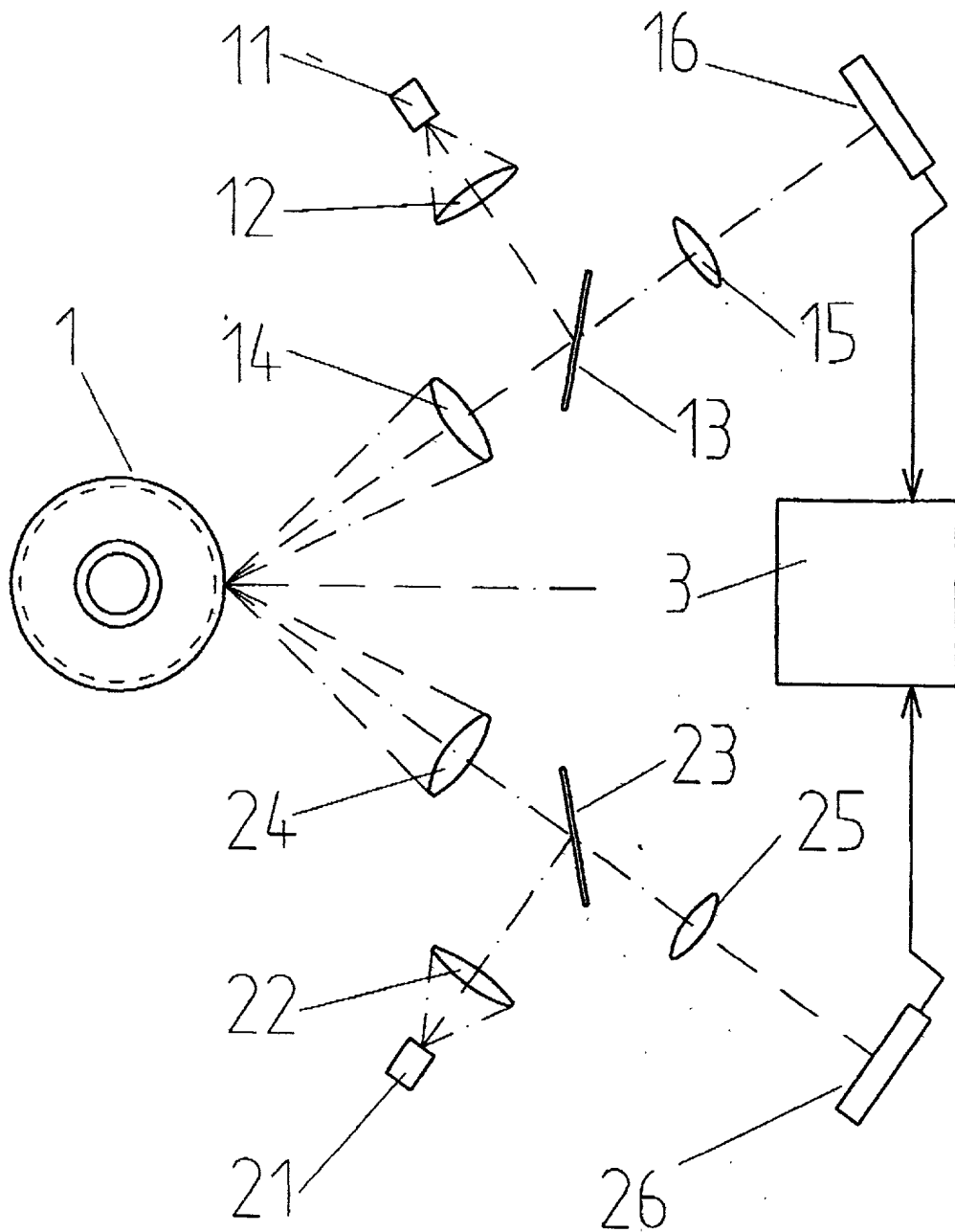
3. Device according to claim 2, characterized in that the illuminating faces (11) and (21) are light exit openings of light guides.

4. Device according to claim 2 and 3, characterized in that the light exit opening of the light guides is formed of line shape.

5. Device according to claim 2, characterized in that the illuminating faces (11) and (21) are lasers with beam expansion optics.

6. Device according to claim 2, characterized in that the illuminating faces (11) and (21) are light sources with the predisposed slot diaphragms.

09/673986



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**Applicant:** Bernd Kiessling et al.**Serial No:** Art Unit:**Filing Date:****Title:** CONTACTLESS MEASUREMENT OF WALL THICKNESS**DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION****Erklärung für Patentanmeldungen mit Vollmacht****German Language Declaration Pch211**

Als nachstehend benannter Erfinder erkläre ich hiermit an Eidesstatt:

As a below named inventor, I hereby declare that:

daß mein Wohnsitz, meine Postanschrift und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

daß ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

Berührungslose Messung der Wanddicke

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CONTACTLESS MEASUREMENT OF WALL THICKNESS

deren Beschreibung (nur eines der nachfolgenden Kästchen ankreuzen)

the specification of which (check only one item below)

Inventor Declaration of Bernd Kiessling

Page 1 of 6

Page 2 of 6

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN /PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 USC 119:

FRÜHERE AUSLÄNDISCHE/PCT ANMELDUNG(EN) UND JEDLICHE PRIORITÄT UNTER 35 USC 119:

Country (if PCT, indicate PCT) Land (falls PCT, PCT angeben)	Application No. Anmeldungsnummer	Date of Filing (day, month, year) Anmeldedatum (Tag, Monat, Jahr)	Priority Claimed under 35 USC 119 Priorität unter 35 USC 119 beansprucht
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Germany	198 18 190.6	23 April 1998	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Ja Nein
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Ich beanspruche hiermit gemäß Absatz 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 120, den Vorzug jeglicher unten aufgeführten U.S.-Anmeldung(en) oder die USA benennende internationale(n) PCT-Anmeldung(en) und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in dieser/diesen früheren Patentanmeldung(en) laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 112 offenbart ist, erkenne ich gemäß Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung(en) und dem nationalen oder internationalen PCT Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal

Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 USC 120:

FRÜHERE AMERIKANISCHE ANMELDUNGEN ODER DIE USA BENENNENDE INTERNATIONALE PCT-ANMELDUNGEN FÜR VORRECHT UNTER 35 USC 120

U.S. APPLICATIONS	STATUS (Check one)
U.S. Application No.	Patented Pending Abandoned
AMERIKANISCHE ANMELDUNGEN	STAND (ein Kästchen ankreuzen)
Seriennummer	Anmeldedatum
	Patentiert Anhängig Aufgegeben

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PCT APPLICATIONS DESIGNATING THE U.S.
PCT Application Number PCT Filing Date U.S.Ser.Nos.
assigned (if any)

DIE USA BENENNENDE PCT-ANMELDUNGEN
PCT-Anmelde- PCT-Anmeldedatum Zugeteilte Serien-
nummer nummern (falls zutreffend)

< > < > < >

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: (Name und Registrationsnummer anführen)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

Horst M. Kasper (Reg. No. 28,559)
Richard T. Laughlin (Reg. No. 17,264)

2 Telefongespräche bitte richten an: (Name und Telefonnummer)
Direct Telephone Calls to: (Name and telephone number)

Horst M. Kasper (908) 757-2839

Postanschrift:
Send Correspondence to:

13 Forest Drive, Warren, N.J. 07059

Ich erkläre hiermit, daß alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und daß ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, daß wissentlich und vorsätzlich falsche Angaben gemäß Paragraph 1001, Absatz 18 der Zivilprozeßordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden können, und daß derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Voller Name des einzigen oder ursprünglichen Erfinders:

Full name of sole or first inventor:

Bernd Kiessling

Unterschrift des Erfinders

Inventor's signature

Bernd Kiessling

Datum

Date

19. 10. 2000

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Voller Name des zweiten Erfinders (falls vorhanden):

Full name of second inventor if any:

20 Peter Hermann

